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Folate Spares Colon and Heart

Evidence that the vitamin folate—known as folic acid on supplement labels—may reduce the risk of colorectal cancer got another boost in a recent study of rats. As the amount of folate in their diet increased, the number of rats that developed tumors of the colon and rectum from high doses of a known carcinogen decreased proportionately. So did the number of tumors per rat. In the human diet, green vegetables, organ meats and citrus are rich sources of folate.

The second leading cause of cancer deaths in the United States, colorectal cancer claims 60,000 lives annually. Each year, 150,000 new cases are diagnosed, and up to 90 percent are thought to be related to diet. Epidemiological studies by others repeatedly have found more precancerous growths—or adenomatous polyps—in the colons of people with low folate intakes or blood levels. They also found the converse: Fewer polyps in the colons of people with high folate intakes or blood levels.

Looking for a cause-and-effect link, ARS researchers turned to a rat model in which the colon cells go through precancerous changes similar to those of humans. One group of rats was given the recommended folate level for rats in their feed. A second group got four times the recommended level, and a third group got 20 times the recommended level, while the control group got no folate.

About 70 percent of the control rats developed tumors after being challenged with high doses of the carcinogen dimethylhydrazine. That dropped to 40 percent of the group given the recommended folate level and to only 10 percent of the group given four times the recommended level. Excessive amounts of folate, however, did not increase protection. In fact, the group getting 20 times the recommended level tended to have more tumors than the rats getting four times the requirement. The same pattern occurred for the number of tumors per rat.

The findings extend those of an earlier study in which extra folate protected the colorectal cells of this breed of rats against precancerous changes after challenge with a much lower dose of the same carcinogen.

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Getting enough dietary folate can reduce the risk of heart disease and stroke, even in those who have a glitch in their genes for converting the amino acid homocysteine to a less toxic relative. Folate—also known as folic acid or folicin—activates one of the enzymes that promote this conversion and thus helps to prevent a backup of homocysteine in the cells, which gets dumped into the blood stream. Studies indicate that elevated blood levels of homocysteine increase the risk of cardiovascular disease, apparently by promoting artery narrowing.

In 1988, a group of Canadian researchers discovered a mutation on the gene that acts as a blueprint for this enzyme. That mutation produces a less efficient enzyme. ARS researchers, in collaboration with one of the Canadian researchers, wanted to know if the enzyme's activity depends on the level of folate in the blood. So they tested blood samples from 365 people enrolled in the National Heart, Lung and Blood Institute's Family Heart Study and found that it did—but only in the subjects who had two copies of the genetic variant, one on each chromosome.

Twelve percent of the subjects had this double variant, the researchers reported in *Circulation* (vol. 93, no. 1). In this double-variant group, those whose blood folate levels were below the study median—6.8 nanograms per milliliter (ng/ml)—had significantly higher homocysteine levels than subjects with only one or no copy of the variant. But those whose folate levels were above the median had normal homocysteine levels.

This genetic variant is quite common, the study found. Forty-seven percent of the subjects had at least one copy, while 41 percent had none. It's easy to get enough folate through the diet. Green vegetables and citrus are rich sources.

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Pros and Cons on Chromium

Body builders will find no help in a bottle of chromium supplements, contrary to claims that it boosts strength and muscle mass while reducing fat. A new, well-controlled study of 36 sedentary young men who volunteered for a weight training program found what other studies have been reporting: Those who took an extra 200 micrograms (mcg) of chromium daily gained no more strength or muscle bulk than those who got a placebo. And none of the men had a significant change in body fat, even after two months of working out five days per week.

One third of the men took chromium picolinate. Another third took chromium chloride—an inorganic form of the mineral—for comparison, while the rest got a look-alike placebo. Their overall strength increased from 28 to 36 percent, on average, depending on the group. Their scores, however, were not statistically different from one another because of the wide range of body types in each group. The researchers concluded in the *American Journal of Clinical Nutrition* (vol. 63, no. 6) that the benefits of chromium supplements on body composition occur only in people with low intakes.

Most Americans consume less than 50 mcg each day—the bottom of the range thought to be adequate—and may be operating on marginal levels. Because the chromium content of foods varies, sometimes dramatically, one insurance against deficiency is to eat a wide variety of foods and choose fortified cereals and whole grain breads over the more refined products.

The study also found that the men taking chromium picolinate, but not chromium chloride, showed early signs of iron deficiency in three different assays of iron status. This suggests that extended use may be detrimental, especially in women before menopause, and needs further study.

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On the positive side, chromium picolinate supplements markedly reduced blood sugar and insulin in Chinese people with type II diabetes in two to four months. The most sensitive measure of diabetic control—hemoglobin A_{1c}—dropped to normal in those taking 1,000 micrograms (mcg) daily. And it was significantly lower in the group taking 200 mcg daily compared to the group that got a placebo. The results of this ARS-led study conducted in China are preliminary and need to be reproduced in this country before chromium can be recommended for the treatment of diabetes. But they hold promise for the mineral to be added to current treatments.

Chinese physicians recruited 180 patients with type II diabetes in three Beijing hospitals and assigned them to three groups of 60 each. One group took 500 mcg of chromium picolinate at two different times daily; another group took 100 mcg twice daily, and the third took a look-alike placebo. All of the patients produced insulin; none was in an advanced stage of the disease.

The patients getting 1,000 mcg—or 1 milligram (mg)—daily ended the four-month study with an average hemoglobin A_{1c} of 6.6 percent, compared to 8.5 percent for the placebo group. This is a measure of how much sugar is bound to hemoglobin, which runs around 6.2 or less in healthy people. Fasting glucose was down to 129 milligrams per deciliter versus 160 mg/dL in the placebo group and around 120 mg/dL in nondiabetic people.

Patients getting 200 mcg daily ended the study with a hemoglobin A_{1c} of 7.5 percent—also significantly below the placebo group. But blood glucose was not significantly lower. Both the high- and low-chromium groups had a significant drop in plasma insulin. People in the early stages of type II diabetes produce more insulin than normal because it's less efficient at clearing blood glucose. Chromium appears to make the self-secreted hormone more efficient. It doesn't affect injected insulin.

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Chromium—The Good Food Contaminant

Cereals, particularly bran cereals, are among the top sources of chromium, according to state-of-the art analyses of 40 foods. Of the seven cereals analyzed, five contained between 10 and 20 percent of the minimum suggested chromium intake in a one- or two-ounce serving. But a slice of whole wheat bread or an ounce of toasted wheat bran provides only about one percent of the minimum, suggesting that much of the chromium in foods is contributed by other factors and is not intrinsic to the food itself. The high levels in cereals probably are inadvertently added during fortification with other minerals or vitamins.

Chromium also may be introduced as a result of processing or handling. One cup of canned mushrooms had more than 10 percent of the suggested minimum chromium intake, as did one teaspoon of cocoa powder. But chocolate syrup had only half as much per serving. Canned whole tomatoes and pineapple slices scored highest in chromium content in this study, with one cup providing 33 to 43 percent of the minimum suggested intake. Many canned and processed foods are prepared in stainless steel vessels, which have a high chromium content. This appears to be a case of good

contamination because the body can convert inorganic chromium to a usable form.

For these analyses, the researcher selected 20 frequently consumed foods and 20 other foods, including cereals, condiments and snack foods, that were expected to have higher chromium levels. There are no comprehensive data bases on the chromium content of foods. And, until a decade ago, analytical methods for detecting chromium in foods were quite unreliable. Recent advances in graphite furnace atomic absorption spectrometry, used in this study, provide a rapid and highly accurate method of detecting the small amounts of chromium in foods.

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Body Fat Scrutinized in Military Women

Middle-aged women in the military who fail to meet the body fat standard based on tape measurements now have some data to question their score. In a study of women between the ages of 40 and 60, the tape measure method overestimated body fat by nine to 14 percent in some women and underestimated it by seven to 11 percent in other women compared to underwater weighing—a long-accepted standard. That's because the equations each branch of the military uses to estimate body fat from circumference measurements of arms, legs and abdomen were developed from studies of younger people.

The researchers wanted to know if the equations accurately reflect body fat in older personnel because service men and women who do not meet the standards must undergo a weight control program until they lose the excess fat. Failing that, they can be subject to discharge. The cutoffs for body fat range from 26 percent for all women in the U.S. Marine Corps to 36 percent for women over age 40 in the U.S. Army.

Based on these standards, the Army equation overestimated body fat in the fewest number of women tested—one out of 52, or two percent of the group. The Navy equation overestimated body fat most often—in seven of 35 women tested, or 20 percent. Most of those who met the standards based on tape measurements also met them in underwater weighing, the researchers reported in *Medicine and Science in Sports and Exercise* (vol. 27, no. 7).

The findings point to the need for a larger study to assess and possibly revise these equations for over-40 personnel. The researchers chose to study older women first because this group is most underrepresented in the current equations. But they suspect the equations may also need revision for older men.

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500 Plus Foods Are Key

The U.S. population gets about 90 percent of its calories, fiber, calcium, iron, fat, saturated fat and eight other nutrients of public health interest from 527 foods, according to newly released data from the USDA 1989-91 nationwide food consumption survey. These 527 foods qualify as key foods because of the amount consumed per capita as well as their nutritional content. Whole milk is a key food for 13 of the 14 nutrients of concern, and two percent milk provides 12 of these nutrients in significant amounts. Eggs and cheddar and mozzarella cheeses contribute 10 or more of the selected nutrients—which include sodium, cholesterol, vitamin A, carotene, vitamin B₆, vitamin C, potassium and zinc in addition to the six already listed. Like milk, many of the top key foods, such as white bread and breakfast cereals, are fortified.

ARS nutritionists updated the list of key foods based on results of the 1989-91 nationwide food consumption survey. It is used to prioritize the foods to be chemically analyzed for the ongoing revision of the electronic nutrient data bases. To determine which foods contribute at least 80 percent of selected nutrients, the nutritionists turn to their electronic recipe files to break down combination foods, such as macaroni and cheese or a fast-food burger, into their ingredients by percentage. For example, macaroni and cheese is about 39 percent macaroni, 35 percent milk, 16 percent cheese, three percent margarine and so on. That allows the nutritionists to add all the pasta, milk, cheese, etc., consumed over the course of a day. They then merge these totals with the nutrient values for each food. A report on the specific procedure will appear in an upcoming issue of the *Journal of Food Composition and Analysis*. Staffers are now developing a key foods list from survey data collected in 1994.

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Stopping Lyme Disease at Its Source

Ticks that transmit Lyme disease to humans may find it deadly to get a free ride on white-tailed deer. That's because of a new deer feeder dubbed "the four-poster" and patented by ARS. The feeder gets its name from four pesticide-loaded rollers that rub tick-killing chemicals on a deer's head and neck as it sticks its head inside the device to feast on corn. Treated deer help eliminate ticks from wooded areas rather than leaving the pests behind to find another host. Because the deer don't eat the pesticide, this method is safe for use during the October-December hunting season when the majority of adult black-legged ticks feed on deer. Eliminating adult ticks prevents egg-laying and another generation.

Pesticides used in the rollers are experimental, but researchers say the "four-poster" is more effective than fencing deer out of tick-infested areas. Lyme disease is most prevalent in the Northeast, the upper Midwest and California. If the studies prove to protect people, individual states could grant special permits to use pesticides on white-tailed deer.

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Antibiotic-Free Goat Milk Assurance

Test kits to check for antibiotic residues in cow's milk also work well with goat's milk. Doubts had existed because goat's milk has a higher somatic cell count and different composition than cow's milk—differences that could affect the outcome of antibiotic residue tests designed for cow's milk. But in a recent study with milk from 85 goats, commercially produced residue test kits designed for cow's milk gave only one false positive outcome in 935 tests.

Surveys indicate at least 5 percent of bulk milk shipments have been found to contain detectable amounts of antibiotics used to treat livestock. This

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potential human health hazard led to development of the residue test kits.

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Irradiation Instead of Fumigation

Two commercial blueberry varieties produced in Florida hold up well under irradiation, a treatment that could replace methyl bromide, now used to rid the fruit of quarantine pests. Methyl bromide, a chemical fumigant, is scheduled to be banned in the United States in 2001. ARS scientists subjected Climax and Sharpblue blueberries to low-dose irradiation with only minor effects that should not affect consumer acceptance, they reported in *HortScience* (vols. 29 & 30). Blueberries shipped to some U.S. and export markets must be certified free of certain quarantine pests. Currently, methyl bromide is the only approved quarantine treatment for blueberries against the apple maggot, blueberry maggot and plum curculio.

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Florida-grown sweet potatoes can be given a light dose of irradiation to control the sweet potato weevil. That's the finding of ARS researchers. Sweet potatoes are an important crop in the southeastern United States, and an excellent market awaits in areas where the weevil is not present. But shipment to weevil-free areas such as California is prohibited unless the product has been fumigated with methyl bromide, the postharvest quarantine treatment approved to kill this pest. And that treatment has its limitations: Sweet potatoes have a shorter shelf life after fumigation, and methyl bromide is scheduled to be phased out by the year 2001. Irradiation, used as a quarantine treatment for potato weevils, leaves no residue and does not adversely affect the taste or appearance of the sweet potatoes, even after they've been cooked.

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